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Report on the Gordon Research Conference on Superconductivity

Les Diablerets, Switzerland, 17-22 september 1995

The conference was held in the village of Les Diablerets, where most of the participants were lodged at the Eurotel and some at the near-by Hotel des Sources. The oral sessions were held at the very nice conference center of Les Diablerets, situated only 3 min walk from the Eurotel. The postersessions were held at the Eurotel in a room adjacent to the lobby. The situation of Les Diablerets and the facilities at the Eurotel and the Conference Center gave an excellent frame for the conference and contributed its success. I would also like to mention here the remarkable service offered by the Eurotel to the participants.

We had 120 participants which is about the optimum for this type of conference. The conference was truly international with participants from Canada, the Czech Republic, France, Germany, Great Britain, Israel, Italy, Japan, New Zealand, the Netherlands, Spain, Switzerland and the United States. The scientific program consisted of 30 invited talks, short poster presentations and 4 poster sessions. A copy of this program as well as a list of the posters are joined to the present report.

The scope of this conference was to address and discuss the present status of the research on high temperature superconductors and other superconducting materials. The conference is one in a series of Gordon conferences on superconductivity held earlier in Oxnard, California. The format of the conference was the one usually used for the Gordon conferences: 3 or 4 talks in the morning, free time for discussions in the beginning of the afternoon followed by a 2 hour poster session. The evening sessions had 2 or 3 talks. Over all the quality of the presentations were excellent. The speakers gave enough background material in the introduction so that the audience could follow the most recent developments. Most of the talks stimulated considerable discussion with a broad participation.

The conference was organized into sessions with two or three talks concentrating on a specific subject. Thus we had a session on new materials focusing on the structural richness of the high temperature superconductors and the possible implications for the critical currents and future applications. We also had a session on the new class of superconducting borocarbides and on heavy fermion superconductors. Several talks addressed experiments probing the nature of the microscopic superconducting state in the high temperature superconductors: photo emission, specific heat, optical properties, neutron scattering, NMR, tunneling and Josephson devices. Other talks discussed the fascinating properties of the vortex states in these materials. Athough the conference was, as earlier conferences in this series, mainly focusing on experimental investigations, a number of theoretical questions were also discussed, in particular the nature of the microscopic state and theoretical aspects of the vortex state. An evening session assessed the potential for future applications.

The poster session was an important part of the conference. A total of 76 posters were presented and these were divided into two parts so that each poster was exposed during two days. This gave ample time to discuss the results presented and thus the posters contributed very much to the overall success of the conference. In order to further improve the communication we also asked each poster presenter to give a very short (max 2 min)

presentation of his or her poster. This gave the participants a brief overview of the subjects treated before the postersession started and clearly improved the communication between the participants.

At the business meeting, devoted mainly to discuss the future conferences of this series, a very large majority among the participants expressed the wish both to continue the conference and that the location alternates between the US and Europe in the future.

In summary, at this conference several of the central and basic questions in the science of superconductivity were discussed. The talks and the following discussions allowed an in depth analysis of these questions. If we judge on the numerous positive reactions by the participants after the conference, it was felt that the conference had achieved its goal in furthering both the science and the scientific exchange among the participants. This, of course, speaks for the excellent contributions from the participants, in the oral presentations, in the discussions and at the posters. We also believe that the special Gordon conference format was an essential factor in this result. We finally conlude that the success of the conference speaks for the vitality of the field of superconductivity and that this certainly call for a continuation of this series and for similar conferences in the future.

Geneva, December 5, 1995

Ø. Fischer

GORDON RESEARCH CONFERENCE ON SUPERCONDUCTIVITY

Eurotel, Les Diablerets, Switzerland september 17 - 22, 1995
R. L. Greene, Ø. Fischer, co-chairs, D. K. Finnemore, vice chair.

ORAL PROGRAM

Monday morning.

8.30 Welcome and introductory remarks. A. H. Cowley, Ø. Fischer

8.40 New materials. C. W. Chu, discussion leader

8.40 J. D. Jorgensen: «Structural optimization of T_c and J_c »

9.30 M. Hervieu: « Bulk and Thin Film Cuprates and Oxycarbonates: Stabilisation of New Superconductors ».

10.20 Break

10.50 K. Kishio: «Stabilization and Enhanced Flux Pinning Behaviour of Hg-based Oxide Superconductors »

11.40 Short Poster presentations

12.30 Lunch

Monday afternoon

4.00 - 6.00 Poster session

6.00 Dinner

Monday evening.

7.30 Optical properties. S. Uchida, discussion leader

7.30 D. van der Marel: « Polarized Angular Resolved Infrared Spectroscopy of High Temperature Superconductors »

8.20 M. Cardona: « Raman Scattering in High Temperature Superconductors: Electrons, Phonons, Electron-Phonon Interactions, and Gaps. »

9.10 R. Hackl: « Raman Scattering Study of Electronic Properties in Cuprate Superconductors »

Tuesday morning

8.30 Borocarbides and Heavy Fermions. K. Kitazawa, discussion leader

8.30 R. D. Cava: « New Materials Research on Intermetallic Superconductors »

9.20 P. Canfield: « Anisotropic Physical Properties of the New Magnetic Superconductors $RENi_2B_2C$ ».

10.10 Break

10.40 F. Steglich: « Superconductivity and Magnetism in Strongly Correlated f-Electron Systems »

11.30 Short poster presentations

12.30 Lunch

Tuesday afternoon

4.00 - 6.00 Poster session

6.00 Dinner

Tuesday evening

7.30 Electronic Properties II. B. Batlogg, discussion leader

7.30 W. Pickett: « Regularities among the Classes of Superconductors - Are There Any? »

8.20 A. Kapitulnik « Magnetic Field Dependence of the Density of States of HTSC as Determined from Specific Heat - Implications for the Vortex Structure »

8.50 A. Junod «Specific Heat of High Temperature Superconductors in Very High Magnetic Fields »

Wednesday morning

8.30 Photoemission. Y. Petroff, discussion leader

8.30 Z. X. Shen: « Momentum Dependent Electronic Structure and Superconducting Gap of the Cuprate Superconductors »

9.00 J. C. Campuzano: « New Results from Angle-Resolved Photoemission Studies of the Normal and Superconducting States of Bi2212»

9.30 P. Aebi: « Fermi Surface Mapping of High Tc Materials using Angle-Scanned Photoemission »

10.00 Break

10.30 Vortices I. P. Kes, discussion leader

10.30 V. B. Geshkenbein: « Hall Effect in the Mixed State of High Temperature Superconductors »

11.00 Ch. Lieber: « Structural Properties and Pinning of Flux-Lines in High T_c Superconductors »

11.30 Short poster presentations

12.30 Lunch

Wednesday afternoon

4.00 - 6.00 Poster session

6.00 Dinner

Wednesday evening

7.30 Business meeting

8.00 Theory. T. M. Rice, discussion leader

8.00 P. W. Anderson: «Recent developments in the theory of HTSC»

8.50 M. Siegrist: «New Phenomena due to Broken Time-Reversal Symmetry in High-T_c Superconductors»

Thursday morning

8.30 Order parameter symmetry. G. Deutscher, discussion leader.

8.30 C. Tsuei: « One-Half Integer Flux Quantization in Tricrystal Rings - a Probe of Pairing Symmetry »

9.20 A. Goldman: «Transverse Magnetization Studies of the Pairing state »

10.10 Break

10.40 Vortices I. G. Crabtree, discussion leader

10.40 D. J. Bishop: « Vortex Lattice Melting in the Oxide Superconductors »

11.30 E. Zeldov: « Thermodynamic Observation of First Order Vortex Lattice Melting Transition »

12.30 Lunch

Thursday afternoon

4.00- 6.00 Poster session

6.00 Dinner

Thursday evening

8.00 Applications. M. Peter, discussion leader

8.00 H. Rietschel: «Large Scale Applications of High-T_c Superconductors »

8.50 S. Wolf: « Electronic Applications From the US View Point »

Friday morning

8.30 Thin films. T. H. Geballe, discussion leader

8.30 D. P. Norton: «Synthesis of Artificially Layered Cuprate Superconductors by Pulsed Laser Deposition »

9.20 J.-P. Locquet: «Superconductivity in O- and Sr-doped 214 Thin Films and Multilayers Grown by Molecular Beam Epitaxy ».

10.10 Break

10.40 Neutronscattering and NMR, H.-R Ott, discussion leader

10.40. H. A. Mook: «Neutron Scattering Measurements of the Spin Fluctuations in High Temperature Superconductors »

11.30 C. P. Slichter: « NMR in High T_c: some Answers and some Questions »

12.20 End of the Conference

12.30 Lunch.

Gordon Conference Poster Sessions
Eurotel, Les Diablerets, 17-22 September 1995

Monday and Tuesday

1. New Materials

   - D.C. Johnston, « Magnetic studies of $Sr_2CuO_2Cl_2$: a model spin ½ square lattice Heisenberg »
   - Y. Maeno, « Highly anisotropic normal–state and superconducting properties of Sr_2RuO_4 »
   - O.V. Misochko, « Raman study of quasi-1D spin ½ antiferromagnet Sr_2CuO_3 and $SrCuO_2$: charge, spin, and lattice dynamics »
   - R.N. Shelton, « Properties of $(Pr_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10-x}$ - a model for suppression of superconductivity by Pr in high T_c cuprates »
   - J.L. Tholence, « New high temperature superconducting materials »

2. Doping Experiments

   - Y. Eckstein, « Similar depression of T_c by Zn and Ni substitution, departure from the universal thermopower behaviour and doping effects in charge compensated cuprate superconductors »
   - J. Halbritter, « O-doping effects in cuprate superconductors »

3. Optical—Microwave
   - M. Decroux, « Temperature dependence of the microwave surface impedance of very thin films of $DyBa_2Cu_3O_7$ »
   - H. Enriquez, « Microwave dissipation of tilted vortices in $Bi_2Sr_2CaCu_2O_8$ single crystals »
   - J. Kircher, « Far-infrared ellipsometry and the c-axis optical response of the cuprates »
   - O.V. Misochko, « Optical study of local oxygen ordering in $YBa_2Cu_3O_{7-\delta}$ single crystals »
   - H. Muto, « Quantum flux and flux trapping in Bi2212 single crystals as studied by ESR spectrometer »

4. Thin Films

   - V. Dediu, « Oxygen diffusion in $GdBa_2Cu_3O_{(7-\delta)}$ thin films during growth »
   - J. Lesueur, « Evidence of an enhanced critical region in the fluctuating regime of YBCO ultra-thin films »
   - V.V. Moshchalkov, « Quantization and confinement effects in

superconducting nanostructures »

- D. Pavuna, « Quantitative analysis of lattice disorder and superconducting properties of $YBa_2Cu_3O_{6.9}$ films »
- H. Raffy, « Superconducting properties and 2D behaviour under magnetic field of $Bi_2Sr_2CaCu_2O_y/Bi_2Sr_2CuO_z$ superlattices »

5. Theory

- D. Baeriswyl, « Thermal fluctuations in high-temperature superconductors »
- J.D. Dow, « Experiment and theory: The case for superconductivity associated with charge-reservoir oxygen, not cuprate-plane Cu »
- M. Franz, « Ginzburg-Landau theory of vortices in d-wave superconductors »
- A.I. Liechtenstein, « Tight-binding model for interlayer coupling and superconductivity in the bi-layer high-T_c compounds »
- V.M. Loktev, « Pairing in 2D fermi-systems mutual attraction »
- K. Maki, « Antiparamagnon and d-wave superconductor in high T_c copper oxides »
- M.A. Mojumder, « Ionic plasmons are mediating bosons in the high-T_c superconductors »
- X. Oudet, « High-T_c superconductors, valence and quantum state »

6. Thermodynamic C_p

- A. Carrington, « Field dependence of the superconducting anomaly in the specific heat of single crystal $HgBa_2Ca_2Cu_3O_{8+\delta}$ »
- J.P. Franck, « A comparison of the enhancement of the low temperature specific heat of Co and Fe doped BISCO 2212 »
- C. Marcenat, « The specific heat of $YBa_2Cu_3O_{6.92}$ in magnetic fields up to 27 Tesla »
- K.A. Moler, « Specific heat of YBCO and BSCCO »

7. Transport

- Y. Ando, « Thermally induced dimensional crossover in single crystal $Bi_2Sr_2CaCu_2O_x$ »
- Y. Ando, « Normal state transport properties of $La_{2-x}Sr_xCuO_4$ in magnetic fields up to 61 T »
- B. Beschoten, « Hall mobility across the insulator-to-superconductor transition in $Bi_2Sr_2(Ca_{7.}Pr_{1-7})Cu_2O_{8-\delta}$ »
- H.J. Trodahl, « Phonon drag thermopower in the cuprates »
- N.L. Wang, « Anisotropic cunductivity in $Bi_2Sr_2CuO_y$ crystals »

Wednesday and Thursday

8. Photoemission

- Jian Ma, « Temperature dependences of the superconducting gap anisotropy in $Bi_2Sr_2CaCu_2O_{8+x}$ »
- M.R. Norman, « Angle resolved photoemission and the superconducting order parameter in Bi-2212 »

9. Vortices

- S. Anlage, « Frequency and field variation if vortex dynamics in $YBa_2Cu_3O_{7-\delta}$ »
- E. Babic, « Dissipation in BSCCO superconductors: An interplay of pinning and anisotropy »
- G. D'Anna, « Vortex motion and noise in clean $YBa_2Cu_3O_{7-\delta}$; the relevance of surfaces and edges »
- M. Charalambous, « I-V curves below picovolt resolution of single crystalline rings of YBCO; new evidence for a glassy phase below $T_M(T_c)$ in YBCO crystals »
- G.W. Crabtree, « Magneto-optical imaging of transport currents »
- R. Griessen, « Dissipative and Hall tunneling in $YBa_2Cu_3O_{7-\delta}$ thin films »
- H.J. Hug, « Observation and manipulation of single vortices »
- D.I. Khomskii, « Charged vortices in high temperature superconductors »
- Ch. Leeman, « Vortex dynamics in the mixed state of $YBa_2Cu_3O_7$ films »
- J.T. Markert, « Observation of extensive fine structure in the vortex dissipation peaks of $YBa_2Cu_3O_{7-\delta}$ single crystals: Intrinsic pinning effects? »
- H. Nordborg, « Path-integral quantum Monte-Carlo simulations of vortex systems »
- Ch. Renner, « Scanning tunneling spectroscopy on high-temperature supercondcutors: A direct probe of the superconducting gap and the vortex lattice »
- S.E. Shafranjuk, « ac-Properties of layered superconductor »
- J.-M. Triscone, « B-T vortex phase diagram in $DyBa_2Cu_3O_7/(Y_{1-x}Pr_x)Ba_2Cu_3O_7$ heterostructures »
- K. Yates, « Effect of pin density on vortex mobility »

10. Theory

- M.V. Ramallo, « Fluctuations in multiperiodic layered

superconductors and implications on the pairing symmetry of HTSC »

- Y. Ren, « Ginzburg-Landau equations and the vortex structure of d-wave superconductors »
- A. Sudbo, « Quantum Monte-Carlo simulations of a one-dimensional copper-oxide model »
- G. Varelogiannis, « Density of states driven anisotropies induced by momentum decoupling in high-T_c superconductors »
- M.B. Walker, « Orthorhombically mixed s and $d_{x^2-y^2}$ wave superconductivity and Josephson tunneling »

11. Pairing

- M.T. Beal-Monod, « Anisotropic « s-d » and « d+s » wave superconductivity models »
- K.A. Moler, « Integral and half-integral Josephson vortices in high-T_c grain boundaries »
- R.J. Radtke, « An alternative to $D_{x^2-y^2}$ pairing in 3D spin-fluctuation-mediated superconductors »
- A. Virosztek, « Charge transfer fluctuations, d-wave superconductivity, and the B_{1g} Raman phonon in the cuprates: A detailed analysis »

12. NMR

- M. Mali, « Intra- and inter-plane coupling in $Y_2Ba_4Cu_7O_{15}$ as revealed by NQR spin-echo double resonance (SEDOR) »
- A. Nath, « Some evidence of magnetic fluctuations in the normal state of $Nd_{1.85}Ce_{0.15}Cu(^{57}Co)O_4$ »
- A. Nath, « Effect of praseodymium substitution on the dynamics of the chain in $Y_{1-x}Pr_xBa_2Cu_3(^{57}Co)O_{7-\delta}$ »

13. Tunneling

- D. Brawner, « Explanation of the zero bias anomaly in single crystal $Bi_2Sr_2CaCu_2O_8$ with intrinsic Josephson tunneling »
- C. Rossel, « Topography and spectroscopy of high-T_c cuprate single crystals by low temperature STM/AFM

14. Neutrons

- G. Czjzeh, « Low-energy magnetic excitations in metallic and superconducting $Nd_{2-y}Ce_yCuO_4$ »

15. Applications

- M. Däumling, « The critical state in thin disk specimens in perpendicular field: A comparison between isotropic Nb_3Sn superconductors of different shape »
- M. Nikolo, « Improvement of wak links and flux pinning, and ac losses in silver-clad thallium based superconducting tapes »